Notice No.1

Rules and Regulations for the Classification of Ships, July 2020

The status of this Rule set is amended as shown and is now to be read in conjunction with this and prior Notices. Any corrigenda included in the Notice are effective immediately.

Please note that corrigenda amends to paragraphs, Tables and Figures are not shown in their entirety.

Issue date: December 2020

Amendments to	**Effective date**	**IACS/IMO implementation (if applicable)**
Part 3, Chapter 2, Section 1	1 January 2021	1 January 2021
Part 3, Chapter 6, Section 7	1 January 2021	1 January 2021
Part 3, Chapter 13, Section 2	1 January 2021	1 January 2021
Part 4, Chapter 1, Section 1	1 January 2021	1 January 2021
Part 4, Chapter 7, Sections 3, 5, 6 & 10	1 January 2021	1 January 2021
Part 4, Chapter 8, Section 2	1 January 2021	1 January 2021

Lloyd's
Register

Part 3, Chapter 2
Materials

■ *Section 1*
Materials

1.2 Steel

Table 2.1.1 Values of *k*$_L$

Specified minimum yield stress in N/mm^2	k_L
235	1,0
265	0,92
315	0,78
355	0,72
390	0,68 (0,66 *see* Note 3)
460 *see* Note 4	0,62 *see* Note 4
Note *1.* Intermediate values by linear interpolation. Note *2.* For the purpose of calculating hull moment of inertia as specified in *Pt 3, Ch 4, 5.8 Hull moment of inertia 5.8.1*, k_L = 1,0. Note *3.* A k_L factor of 0,66 may be applied to all ship types provided that a fatigue assessment is carried out as required by *Pt 3, Ch 2, 1.2 Steel 1.2.4*. Note *4.* Grade only applies to thickness above 50 mm for upper deck, hatch coamings, shear strake, uppermost strake of longitudinal bulkhead and other longitudinal strength members in way of the above structures of container ships. The requirements specified in *Ch 3, 3 Higher strength steels for ship and other structural applications* of the ~~Rules for Materials~~ *Rules and Regulations for the Classification of Materials, July 2020* apply, *see Pt 3, Ch 2, 1.2 Steel 1.2.4* and *Pt 3, Ch 2, 1.2 Steel 1.2.5*. Use of this grade on other ship types or for other applications/thicknesses will be specially considered.	

Part 3, Chapter 6
Aft End Structures

■ *Section 7*
Sternframes and appendages

7.5 Rudder trunks

7.5.1 The requirements of this sub-section apply to trunk configurations which are extended below the stern frame and arranged in such a way that the trunk is stressed by forces due to rudder action.

~~7.5.1~~ 7.5.2 Rudder trunks ~~extending above or below the stern frame~~ are to be constructed of steel of a weldable quality with a carbon content not exceeding 0,23 per cent on ladle analysis or a carbon equivalent (CEQ) not exceeding 0,41 per cent.

Existing 7.5.2 to 7.5.3 have been renumbered 7.5.3 to 7.5.4.

~~7.5.4~~ 7.5.5 The fillet shoulder radius, r, of webs connected to the rudder trunk see *Figure 6.7.4 Rudder trunk fillet shoulder radii*, are to be as large as practicable and ~~are in no case to be less than~~: as follows:

~~r =~~ $r = 0{,}1 d_c$ r mm

but not less than

a) 60 mm when $\sigma_b \geq \frac{40}{k}$ N/mm^2

~~r = the greater of 0,1dc, and~~ b) 30 mm when $\sigma_b < \frac{40}{k}$ N/mm^2

where

d_c = rudder stock diameter as defined in *Table 13.2.4 Rudder stock diameter*

σ_b = bending stress in the rudder trunk, in N/mm^2 *see Table 13.2.5 Rudder stock permissible stress*

k = material factor as defined in *Table 13.2.1 Rudder material factor, k*.

The radius may be obtained by grinding. If disk grinding is carried out, score marks are to be avoided in the direction of the weld. The radius is to be checked with a template for accuracy. At least four profiles are to be checked. A report is to be submitted to the Surveyor.

Existing 7.5.5 has been renumbered 7.5.6.

Existing Figure 6.7.4 has been unchanged.

~~7.5.6~~ 7.5.7 ~~Where the rudder stock is arranged in such a way that it will impose forces on the rudder trunk, t~~ The scantlings of the trunk are to be as follows:
(a) the equivalent stress due to bending and shear is not exceed 0,35σ,
(b) the bending stress, σ_b, of fabricated rudder trunks is to be less than $\frac{80}{k}$ N/mm^2
where

σ_b = bending stress in the rudder trunk, in N/mm^2 *see Table 13.2.5 Rudder stock permissible stress*

k = as defined in *Table 13.2.1 Rudder material factor, k* but is not to be taken less than 0,7

σ = minimum specified yield stress, in N/mm^2

For calculation of bending stress, σ_b, the span to be considered is the distance between the mid-height of the lower rudder stock bearing and the point where the trunk is clamped into the shell or the bottom of the skeg.

Part 3, Chapter 13
Ship Control Systems

■ *Section 2*
Rudders

2.3 Materials (part only shown)

2.3.3 For rudder stocks, pintles, coupling bolts and keys the minimum specified yield stress is not to be less than 200 N/mm^2.

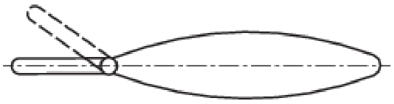
2.3.4 For ~~all parts of the rudder, including~~ rudder stocks, pintles, coupling bolts and keys having a specified minimum yield stress differing from 235 N/mm^2, the material factor, *k* is to be determined in accordance with *Table 13.2.1 Rudder material factor, k.*

2.3.5 For rudder blade and internal structure having a specified minimum yield stress between 235 N/mm^2 and 355 N/mm^2, the material factor, *k* is to be determined in accordance with *Table 13.2.1 Rudder material factor, k*.

2.4 Welding and design details (part only shown)

2.4.3 The rudder, in way of rudder horn recesses of semi-spade rudders, are to have well radiused corners. The corner radii except in way of solid part in cast steel are not to be less than 5 times the local rudder plate thickness, but in no case less than 100 mm. Welding in the rudder side plating is to be positioned away from these corner radii. The weld connecting the side plate and the leading edge plate in way of these radiused corners is to be ground smooth.

(Part only shown)
Table 13.2.2 Rudder profiles

Profile Type	K2	
	Ahead condition	Astern condition
High lift rudders 	1,70	~~To be specially considered~~ 1,30
Note For rudder profiles not defined above, the value of K_2 may be determined on the basis of experimental results. These results are to be submitted for consideration.		

2.10 Rudder stock scantlings

2.10.2 Before significant reductions in rudder stock diameter due to the application of steels with minimum specified yield stresses exceeding 235 N/mm^2 are granted, LR may require the evaluation of the rudder stock deformations. Large deformations of the rudder stock are to be avoided in order to avoid excessive edge pressures in way of bearings.

2.11 Rudder blade

Table 13.2.6 Double plated rudder construction

Item		Requirement	
(1) Rudder side, top and bottom plating		~~$t = 5{,}5\, s\, \beta \sqrt{k\left(T + \left(\frac{C_R \times 10^{-4}}{A}\right)\right)}$+2,5 mm~~ $t = 5{,}5\, s\, \beta \sqrt{k_L\left(T + \left(\frac{C_R \times 10^{-4}}{A}\right)\right)}$+2,5 mm	
(2) Webs, vertical and horizontal		$t_w \geq$ 0,7t but is not to be less than 8 mm	
(3) Nose plate		$t_n \geq$ 1,25t but need not exceed 22 mm	
(4) Mainpiece, (*see* Notes 1 and 2)	Rectangular (fabricated)	Breadth and width ≥ d_c The side plating of the mainpiece is to extend 0,2c and is to be in accordance with (1) and the vertical webs as per (2), but in no case are either to be less than t_M.	~~$t_M \geq 8{,}5 + 0{,}56\sqrt{d_c}\sqrt[3]{k}$ mm~~ $t_M \geq 8{,}5 + 0{,}56\sqrt{d_c}\sqrt[3]{k_L}$ mm (*see* Note 3 and 4)
	Tubular	Inside diameter ≥ d_c	

Symbols

T = draught, in m, as given in *Pt 3, Ch 1, 4.2 Principal particulars*;

C_R = rudder force, in N, as defined in *Pt 3, Ch 13, 2.6 Rudder force 2.6.1*;

A = rudder area, in m^2;

β = $\sqrt{1{,}1 - 0{,}5\left(\frac{s}{b}\right)^2}$; max. 1,00 if b/s ≥ 2,5

k_L = material factor as defined in ~~*Pt 3, Ch 13, 2.3 Materials 2.3.4*~~ *Pt 3, Ch 2, 1.2 Steel Table 2.1.1 Values of kL*

s = smallest unsupported width of plating in m

b = greatest unsupported width of plating in m

c = chord length in m, as defined in *Figure 1.2.1 Rudder co-ordinate system*.

Note 1. The mainpiece bending stresses are to be not greater than those in *Table 13.2.8 Rudder blade permissible stresses*.

Note 2. The mainpiece plating attached to solid forged or cast parts, is not to be less than that required by *Pt 3, Ch 13, 2.12 Connections of rudder blade structure with solid parts*.

Note 3. The stock diameter to be used for calculating the mainpiece plate thickness is to be based on the mild steel stock scantlings, as given in *Table 13.2.4 Rudder stock diameter*.

Note 4. The requirement of t_M need only be applied to the upper part of the rudder plate:

a. for semi spade rudders; above a point midway between the lowest pintle and the bottom of the rudder.
b. for spade rudders; above a point one third of the height of the rudder above the base.

Table 13.2.7 Single plate rudder construction

Item	Requirement
(1) Blade thickness	The greater of; ~~$t_b = 1,5\,s\,V\sqrt{k + 2,5}$; or 10 mm.~~ $\boxed{t_b = 1,5\,s\,V\sqrt{k_L + 2,5}\text{ ; or 10 mm.}}$
(2) Arms	$t_a = t_b$ The section modulus is not to be less than: $Z_a = 0,5\,s\,{C_1}^2 V^2 k$ cm^3
(3) Mainpiece, *see* Note 1	As per *Table 13.2.4 Rudder stock diameter*
Symbols	
s = spacing of stiffening arms, in m, but is not to exceed 1 m. *V* = speed in knots, as defined in *Pt 3, Ch 13, 2.6 Rudder force 2.6.1*. C_1 = horizontal distance from the aft edge of the rudder to the centreline of the rudder stock, in m. k_L = material factor as defined in *Pt 3, Ch 2, 1.2 Steel Table 2.1.1 Values of* k_L	
Note 1. For spade rudders the lower third may be taper down to 0,75 d_c.	

Table 13.2.8 Rudder blade permissible stresses

Item	Permissible stress, N/mm^2		
	Bending stress, σ_b	Shear stress, τ	Equivalent stress, σ_c
Rudder blade, clear of cut-outs	~~$\frac{110}{k}$~~ $\boxed{\frac{110}{k_L}}$	~~$\frac{50}{k}$~~ $\boxed{\frac{50}{k_L}}$	~~$\frac{120}{k}$~~ $\boxed{\frac{120}{k_L}}$
Rudder blade in way of cut-outs, of semi-spade rudders	75	50	100
Symbols			
k_L = material factor as defined in *Pt 3, Ch 2, 1.2 Steel Table 2.1.1 Values of kL*			

2.12 Connections of rudder blade structure with solid parts

2.12.1 Solid parts in forged or cast steel, which house the rudder stock or the pintle, are to be provided with protrusions, except as follows, see *Figure 13.2.4 Cross-section of the connection between rudder blade structure and rudder stock housing, example with opening in only one side shown*. These protrusions are not required when the web plate thickness is less than:

(a) 10 mm for web plates welded to the solid part on which the lower pintle of a semi-spade rudder is housed and for vertical web plates welded to the solid part of the rudder stock coupling of spade rudders.
(b) 20 mm for other web plates.

2.12.2 The solid parts are in general to be connected to the rudder structure by means of two horizontal web plates and two vertical web plates, see *Figure 13.2.4 Cross-section of the connection between rudder blade structure and rudder stock housing, example with opening in only one side shown*.

2.12.3 The minimum section modulus, *Z*s, of the cross-section of the structure of the rudder blade formed by vertical web plates and rudder plating, which is connected with the solid part where the rudder stock is housed is to be not less than:

~~$w_s = c_s {d_c}^3 \left(\frac{H_E - H_X}{H_E}\right)\left(\frac{k}{k_s}\right) \times 10^{-4}$ cm^3~~

$$\boxed{Z_s = c_s {d_c}^3 \left(\frac{H_E - H_X}{H_E}\right)\left(\frac{k}{k_s}\right) \times 10^{-4} \text{ cm}^3}$$

where

c_s = coefficient, to be taken equal to:
= 1,0 if there is no opening in the rudder plating or if such openings are closed by a full penetration welded plate.
= 1,5 if there is an opening in the considered cross-section of the rudder.
d_c = rudder stock diameter, in mm.
H_E = vertical distance between the lower edge of the rudder blade and the upper edge of the solid part, in m.
H_X = vertical distance between the considered cross-section and the upper edge of the solid part, in m.
k_L = material factor for the rudder blade plating ~~= k_L~~, *see* ~~*Pt 3, Ch 13, 2.3 Materials 2.3.4*~~ *Pt 3, Ch 2, 1.2 Steel Table 2.1.1 Values of* k_L
k_s = material factor for the rudder stock, see *Pt 3, Ch 13, 2.3 Materials 2.3.4*.

2.12.4 The actual section modulus of the cross-section of the structure of the rudder blade is to be calculated with respect to the symmetrical axis of the rudder, *see* the x-x axis in *Figure 13.2.4 Cross-section of the connection between rudder blade structure and rudder stock housing, example with opening in only one side shown*. The breadth of the rudder plating, b, to be considered for the calculation of section modulus is to be not greater than:

$b = s_v + \frac{2H_x}{3}$ m

where

s_v = spacing between the two vertical webs, in m.

Where openings for access to the rudder stock nut are not closed by a full penetration welded plate, they are not to be included in the section modulus calculations.

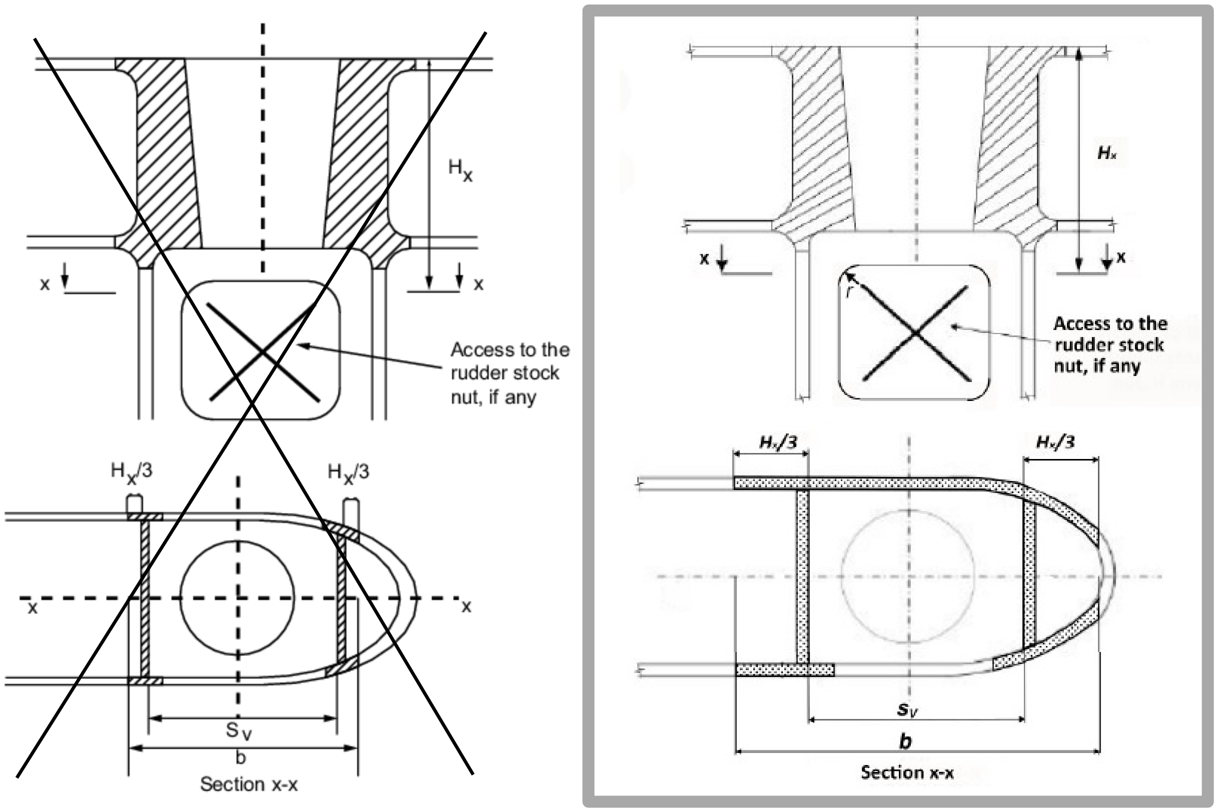

H_x
x
x
Access to the rudder stock nut, if any
H_x/3
H_x/3
x
x
S_V
b
Section x-x
H_x
x
x
r
Access to the rudder stock nut, if any
H_x/3
H_x/3
S_V
b
Section x-x

Figure 13.2.4 Cross-section of the connection between rudder blade structure and rudder stock housing, example with opening in only one side shown

2.14 Cone couplings with key

2.14.1 Cone couplings without hydraulic arrangements for mounting and dismounting the coupling are to have a taper ratio, θt on diameter of 1:8 to 1:12;

where

$$\cancel{\theta_t = \frac{d_c - d_u}{l}}$$

$$\boxed{\theta_t = \frac{d_c - d_u}{l_c}}$$

d_c and d_u are defined in *Figure 13.2.8 Cone coupling with key*.

l_c is defined in *Figure 13.2.9 Cone length and coupling length*.

The cone shapes are to fit exactly. The cone coupling is to be secured by a nut and the nut itself is to be secured, e.g. by a securing plate, *see Figure 13.2.8 Cone coupling with key*.

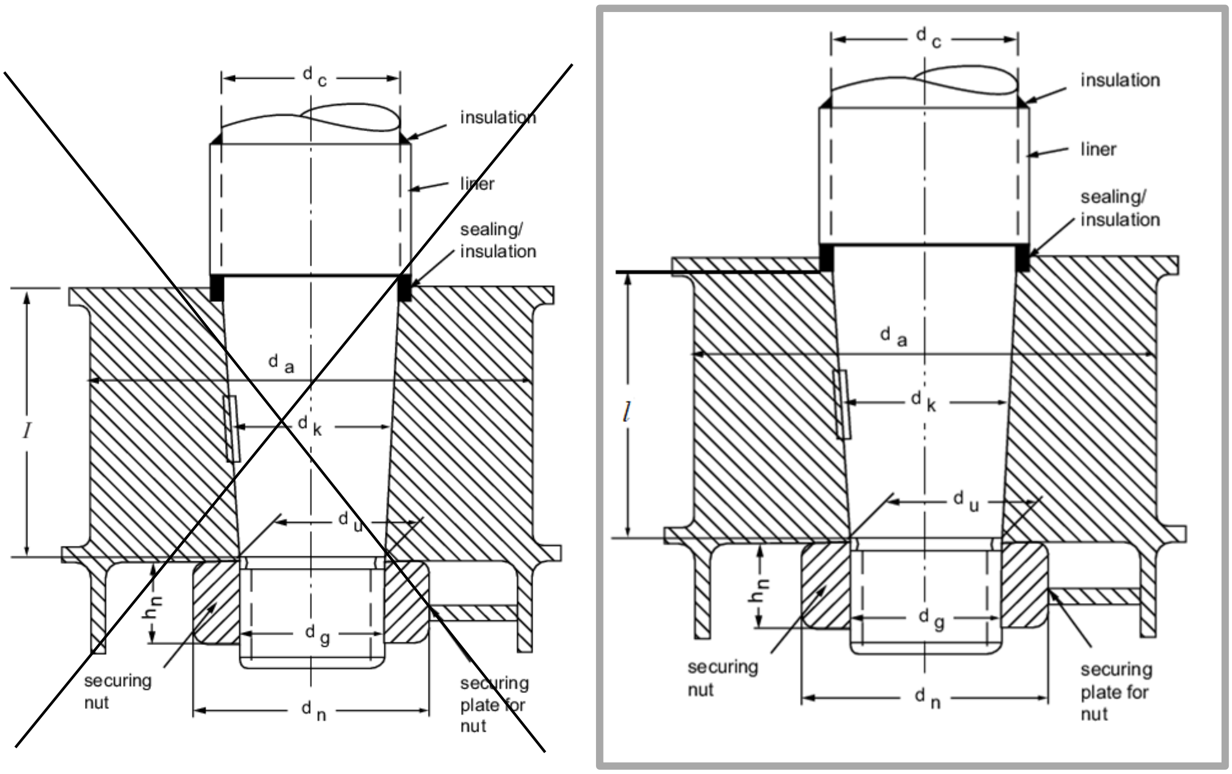


Figure 13.2.8 Cone coupling with key

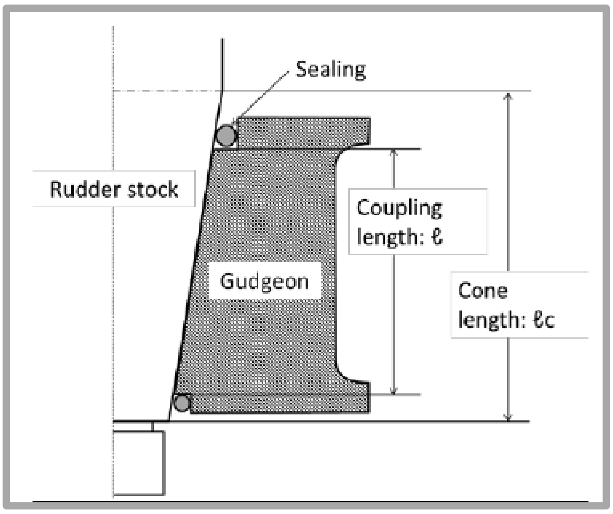


Figure 13.2.9 Cone length and coupling length

2.14.5 The dimensions of the securing nut are to be in accordance with *Table 13.2.11 Securing nut dimensions*, *see also Figure 13.2.8 Cone coupling with key*.

Table 13.2.11 Securing nut dimensions

Item	Requirement
External thread diameter	$d_g \geq 0{,}65\, d_c$
Height	$h_n \geq 0{,}6\, d_g$
Outer diameter	The greater of the following: a. $d_n \geq 1{,}2$ ~~d_i~~ d_u b. $d_n \geq 1{,}5$ ~~d_u~~ d_g
Symbols, see *Figure 13.2.8 Cone coupling with key*	

d_c = stock diameter, in mm

d_g = external thread diameter, in mm

h_n = height of securing nut, in mm

d_n = minimum distance across flats of securing nut, in mm

d_u = inner diameter of securing nut, in mm

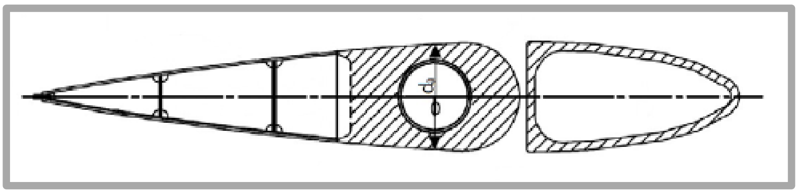


Figure 13.2.10 Gudgeon outer diameter (d_a) measurement

2.15 Cone couplings with special arrangements for mounting and dismounting the couplings

2.15.4 The push-up pressure, P_{req} is not to be less than the greater of the two following values:

P_{req1} = $\frac{2Q_F}{{d_m}^2\, l\, \pi\, \mu_0}$ N/mm^2

P_{req2} = $\frac{6M_b}{l^2 d_m}$ N/mm^2

where

Q_F = design yield moment of rudder stock, in Nm, as defined in *Pt 3, Ch 13, 2.14 Cone couplings with key 2.14.3*.

d_m = mean cone diameter in, mm = $\frac{(d_u+d_c)}{2}$.

l = ~~cone~~ coupling length in, mm, see *Figure 13.2.8 Cone coupling with key*.

M_b = bending moment in the cone coupling (e.g. in case of spade rudders), in Nm.

μ_0 = frictional coefficient, to be taken as 0,15.

d_u = upper cone diameter, see *Figure 13.2.8 Cone coupling with key*

d_c = lower cone diameter, see *Figure 13.2.8 Cone coupling with key*

It has to be proved by the designer that the push-up pressure does not exceed the permissible surface pressure in the cone. The permissible surface pressure is to be determined by the following formula:

p_{perm} = $\frac{0{,}95\, \sigma_g (1-\alpha^2)}{\sqrt{3+\alpha^4}} - P_b$

where

P_b = $\frac{3{,}5 M_b}{d_m\, l^2} 10^3$

σ_g = minimum specified yield stress of the material of the gudgeon in N/mm^2.

α = $\frac{d_m}{d_a}$

d_m = mean cone diameter in, mm.

d_a = outer diameter of the gudgeon to be not less than 1,25 *dc*, in mm, *see Figure 13.2.8 Cone coupling with key* and *Figure 13.2.10 Gudgeon outer diameter (da) measurement*.

ℓ = ~~cone~~ coupling length in, mm, *see Figure 13.2.8 Cone coupling with key*.

M_b = bending moment in the cone coupling (e.g. in case of spade rudders), in Nm.

2.16 Pintles

Table 13.2.12 Pintle requirements

Item	Requirement	
(1) Pintle diameter, in mm	$d_p = 0{,}35\sqrt{F_{bear}k_p}$	
(2) Pintle taper	Method of assembly	Taper (on diameter)
	Keyed and other manually assembled pintles applying locking by securing nut	1:8 – 1:12
	Pintles mounted with oil injection and hydraulic nut	1:12 – 1:20
(3) Pintle bearing length	$d_{pl} \le l_p \le 1{,}2\, d_{pl}$	
(4) Pintle housing/gudgeon	$b_g \ge 0{,}25\, d_{pl}$	
(5) Liner or bush in way of pintle bearings, in mm	$t = 0{,}01\sqrt{F_{bear}}$	
Symbols		
k_p = material factor for pintle, as defined in *Pt 3, Ch 13, 2.3 Materials 2.3.4* F_{bear} = bearing force, in N d_p = actual pintle diameter measured to the inside of the liner, in mm d_{pl} = diameter measured to the outside of the pintle liner, in mm b_g = thickness of pintle housing/gudgeon in way of pintles (measured from the outside of bush if fitted).		
Note 1. The minimum dimensions of threads and nuts are to be determined according to *Table 13.2.11 Securing nut dimensions*.		

2.16.5 The required push-up pressure for pintle is to be determined by the following formula:

$$P_{req} = 0{,}4\,\frac{F_1\, d_p}{{d_m}^2\, l}\ \text{N/mm}^2$$

where

d_m and l are defined in *Pt 3, Ch 13, 2.15 Cone couplings with special arrangements for mounting and dismounting the couplings 2.15.4*.

F_1 = supporting force in the pintle, in N
d_p = actual pintle diameter measured to inside of liner, in mm.

The push-up length is to be calculated in accordance with *Pt 3, Ch 13, 2.15 Cone couplings with special arrangements for mounting and dismounting the couplings 2.15.5*, using the required push-up pressure and properties for the pintle.

2.17 Bearings

2.17.3 The allowable surface pressure, q_a, is to be as required by *Table 13.2.14 Allowable surface pressure, q_a*. Values higher than those given in *Table 13.2.14 Allowable surface pressure, q_a* may be taken in accordance with manufacturer's specifications providing that they are verified through testing to the satisfaction of LR. For synthetic bearing materials with a hardness greater than 60 Shore D, attention is drawn to the requirements of Notes 2 and 3 in *Table 13.2.14 Allowable surface pressure, q_a*.

Table 13.2.13 Bearings

Item	Requirement	
(1) Bearing surface area	$\cancel{A_B = \frac{B}{q_a}\,\text{mm}^2}$ $\boxed{A_B = \frac{F_{bear}}{q_a}\,\text{mm}^2\ 1}$	
(2) Bearing length	The length/diameter ratio of the bearing surface is not to be greater than 1,2.	
(3) Clearance	Bearing material	Minimum clearance (on diameter)
	Metal	$0{,}001d + 1{,}0$ mm
	Synthetic	*See* Notes 1, 2, 3 and 4
(4) Liners and bushes	Material	Minimum thickness
	Metal and synthetic material	8 mm
	Lignum vitae	22 mm
(5) Main bearing housing wall thickness, *see* Note 5	Greater than 0,2d_c	
Symbols		
A_B = bearing surface, in mm^2, defined as the projected area (length x outer diameter) of liner ~~d~~d_c = stock diameter, as calculated in *Table 13.2.4 Rudder stock diameter*, or pintle diameter as calculated in *Table 13.2.12 Pintle requirements* ~~B~~F_{bear} = bearing force, in N q_a = allowable surface pressure, see *Table 13.2.14 ~~Maximum~~ Allowable surface pressure q_a*.		
Note 1. If non-metallic bearing material is applied, the bearing clearance is to be specially determined considering the material's swelling and thermal expansion properties. This clearance is not to be less than 1,5 mm on bearing diameter unless a smaller clearance is supported by the manufacturer's recommendation and there is documented evidence of satisfactory service history with a reduced clearance. Note 2. For bearings which are pressure lubricated the clearance must be restricted to enable the pressure to be maintained. Note 3. The value of the proposed minimum clearance is to be indicated on plans submitted for approval. Note 4. Proposals for higher pressures or other materials will be specially considered on the basis of satisfactory test results. Note 5. Where web stiffening is fitted on the bearing, a reduction in wall thickness will be considered.		

Table 13.2.14 ~~Maximum~~ Allowable surface pressure q_a

Bearing material	q_a (N/mm^2) (*see* Note 1)
Lignum vitae	2,5
White metal, oil lubricated	4,5
Synthetic material with hardness ~~between~~ greater than 60~~ and 70~~ Shore D (*see* Note 2)	5,5 (*see* Note 3)
Steel (*see* Note 4) and bronze and hot-pressed bronze-graphite materials	7,0
Note 1. Proposals for higher pressures will be specially considered on the basis of satisfactory test results. Note 2. Indentation hardness test at 23°C and with 50 per cent moisture according to a recognised standard. Synthetic bearing materials are to be of an approved type. Note 3. Surface pressures exceeding 5,5 N/mm^2 may be accepted in accordance with bearing manufacturer's specification and tests, but in no case more than 10 N/mm^2. Note 4. Stainless and wear-resistant steel in an approved combination with stock liner.	

Part 4, Chapter 1
General Cargo Ships

■ *Section 1*
General

1.3 Class notations

1.3.2 Where a ship has been specially strengthened for heavy cargoes in accordance with the requirements listed in *Pt 4, Ch 7, 8.2 Carriage of heavy cargoes*, it will be eligible to be classed **100A1 strengthened for heavy cargoes**. Ships with length *L* greater than 150 metres are also to comply with

- *Pt 4, Ch 7, 3.5 Additional requirements for ships not built to the IACS Common Structural Rules*,
- *Pt 4, Ch 7, 5.4 Additional requirements for ships not built to the IACS Common Structural Rules*,
- *Pt 4, Ch 7, 6.4 Additional requirements for ships not built to the IACS Common Structural Rules* and
- *Pt 4, Ch 7, 10.7 Additional requirements for ships not built to the IACS Common Structural Rules.*

Part 4, Chapter 7
Bulk Carriers

■ *Section 3*
Longitudinal Strength

3.5 Additional requirements for ships not built to the IACS Common Structural Rules

3.5.1 Bulk Carriers not built to the IACS Common Structural Rules are to comply with the requirements of this sub-section.

3.5.2 The safety factor with respect to lateral buckling of longitudinal ordinary stiffeners required by *Pt 3, Ch 4, 7.5 Scantling Criteria 7.5.1* is to be 1,265 for the following areas:

- hatchway coaming
- inner bottom
- sloped stiffened panel of topside tanks and hopper tanks (if any)
- inner side (if any)
- side shell (if directly bounding the cargo hold)

■ *Section 5*
Shell Envelope Plating

5.4 Additional requirements for ships not built to the IACS Common Structural Rules

5.4.1 Bulk Carriers not built to the IACS Common Structural Rules are to comply with the requirements of this sub-section.

5.4.2. The side shell plate between two points located at 0,125 l above and 0,125 l below the intersection of side shell and bilge hopper sloping plate or inner bottom plate is to be not be less than grade D/DH. The span of the side frame, l, is defined as the distance between the supporting structures.

5.4.3 In case of side frames built with multiple spans, the above requirements apply to the lower part only. (*See Figure 7.5.1 Extent of Grade D/DH material for side shell plating*).

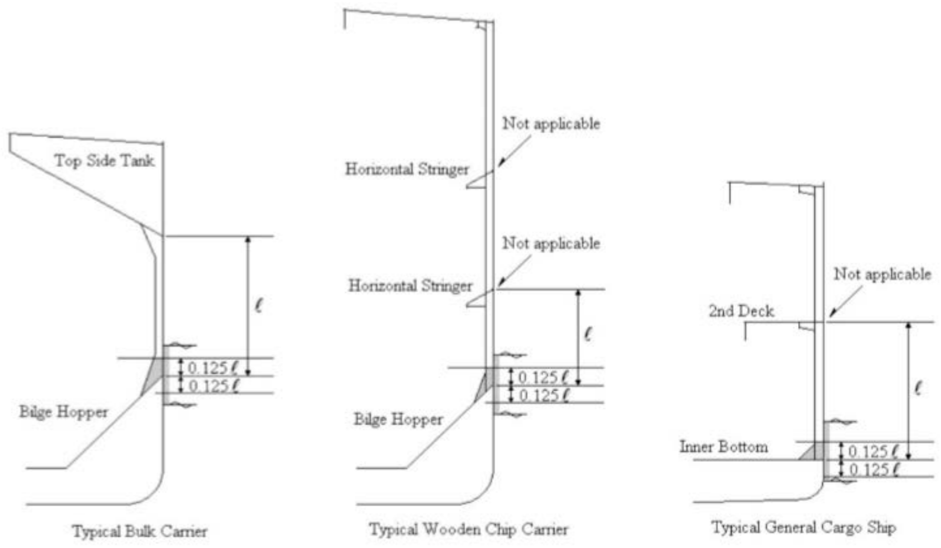


Figure 7.5.1 Extent of Grade D/DH material for side shell plating

■ *Section 6*
Shell Envelope Framing

6.4 Additional requirements for ships not built to the IACS Common Structural Rules

6.4.1 Bulk Carriers not built to the IACS Common Structural Rules are to comply with the requirements of this sub-Section.

6.4.2 For ships with single side structures, the material grade of the lower bracket of side frame shall not be less than grade D/DH.

6.4.3 The safety factor with respect to lateral buckling of transverse ordinary stiffeners is to be 1,15 and calculated in accordance with the *ShipRight Guidance Notes for ShipRight SDA Buckling Assessment*.

■ *Section 10*
Bulkheads

10.7 Additional requirements for ships not built to the IACS Common Structural Rules

10.7.1 Bulk Carriers not built to the IACS Common Structural Rules are to comply with the requirements of this sub-Section.

10.7.2 The safety factor with respect to lateral buckling of ordinary stiffeners on transverse bulkheads and transverse bulkhead stools is to be 1,15 and calculated in accordance with the *ShipRight Guidance Notes for ShipRight SDA Buckling Assessment*.

Part 4, Chapter 8
Container Ships

■ *Section 2*
Materials

2.3 Requirements for the use of thick steel plates

2.3.1 This Section provides the requirements for crack arrest design to reduce the risk of brittle fractures in container ships where thick steel plates are applied for longitudinal structural members ~~with~~ in the upper deck region ~~in the cargo hold region~~. The upper deck region comprises upper deck plating, hatch side coaming plating, hatch coaming top plating and attached longitudinals.

2.3.3 This Section applies to plates having specified minimum yield strength of 355, 390 and 460 N/mm^2. Steels and weldments are to comply with the toughness requirements of *Ch 3 Rolled Steel Plates, Strip, Sections and Bars*, *Ch 11 Approval of Welding Consumables* and *Ch 12 Welding Qualifications of the Rules for the Manufacture, Testing and Certification of Materials, July 2020* ~~(hereinafter referred to as the Rules for Materials)~~.

2.3.4 Where steel having specified minimum yield strength of 460 Nmm^{2} is utilised the material grade is to be EH.

~~2.3.4~~2.3.5 The approach in this Section generally applies to the erection block-to-block joints. Appropriate measures are to be considered to prevent large scale fracture of the hull girder in anticipation of the following:

(a) Crack initiation in the block-to-block butt weld joint in either the hatch side coaming or upper deck. Crack propagates along the butt weld joint without deviation.
(b) Crack initiation in the block-to-block butt weld joint in either the hatch side coaming or upper deck. Crack propagates away from the butt weld joint running into base metal.
(c) Crack initiation in any welded joint, for example in way of attachment welds, and deviates away from the butt weld joint running into base metal.

Existing paragraph 2.3.5 has been renumbered 2.3.6.

~~2.3.6~~2.3.7 A number of measures are given in *Table 8.2.1 Preventative measures to be used in design and construction for thick steel plates* which are considered to be acceptable means of addressing the cases given in *Pt 4, Ch 8, 2.3 Requirements for use of thick steel plates ~~2.3.4~~2.3.5*. A range of thicknesses is shown for the different strength grades of steel. Where the maximum as-built thickness of the hatch coaming top plate and side plate falls within this range, measures are to be selected as shown in the Table. If the as-built thickness of the hatch coaming top plate and side plate is below the values contained in the Table, then additional measures are not necessary regardless of the thickness and yield strength of the upper deck plating. The application of these measures is described in *Pt 4, Ch 8, 2.3 Requirements for use of thick steel plates ~~2.3.7~~2.3.8* to *Pt 4, Ch 8, 2.3 Requirements for use of thick steel plates ~~2.3.11~~2.3.13*.

~~2.3.7~~2.3.8 Where Measure 1 is required in *Table 8.2.1 Preventative measures to be used in design and construction for thick steel plates*, 100 per cent ultrasonic testing in accordance with *Ch 13, 2.12 Non-destructive examination of welds* of the ~~Rules for Materials~~ *Rules and Regulations for the Classification of Materials, July 2020*, both application and acceptance criteria, is to be carried out on all block-to-block butt joints of all upper flange longitudinal structural members in the cargo hold region. Upper flange longitudinal structural members include the topmost strakes of the inner hull/bulkhead, the sheer strake, main deck, coaming plate, coaming top plate, and all attached longitudinal stiffeners. These members are defined in *Figure 8.2.1 Upper flange longitudinal structural members*.

Existing 2.3.10 has been renumbered 2.3.9 and amended as shown below:

~~2.3.10~~2.3.9 Where Measure ~~4~~ 2 is required as a result of the assessment carried out in accordance with the *ShipRight Procedure for the Use of Enhanced NDE for Container Ships*, *see Pt 4, Ch 8, 2.3 Requirements for the use of thick steeled plates 2.3.10(d)* ~~required~~ in *Table 8.2.1 Preventative measures to be used in design and construction for thick steel plates*, there may be a need for periodic NDE during service. ~~in accordance with Chapter 3 of the *ShipRight Procedure for the Use of Enhanced NDE in Container Ships*~~ For such cases the frequency and extent is to be agreed with LR.

Existing 2.3.8 has been renumbered 2.3.10 and amended as shown below.

~~2.3.8~~2.3.10 Where Measure ~~2~~ 3 is required in *Table 8.2.1 Preventative measures to be used in design and construction for thick steel plates*, the following are considered to be acceptable examples of brittle crack arrest design for the case given in *Pt 4, Ch 8, 2.3 Requirements for use of thick steel plates ~~2.3.4~~*2.3.5(a):

(a) Where the block-to-block butt welds of the hatch side coaming plate and those of the upper deck are staggered, this offset is to be greater than or equal to 300 mm. This offset distance is defined in *Figure 8.2.2 Minimum offset between block-to-block butt welds of the hatch side coaming and those of the upper deck staggered*. Brittle crack arrest steel, as defined in *Pt 4, Ch 8, 2.3 Requirements for use of thick steel plates ~~2.3.12~~2.3.14*, is to be provided for the hatch side coaming plate.

(b) Where crack arrest holes are provided in way of the block-to-block butt welds at the region where the hatch side coaming weld meets the deck weld, *see Figure 8.2.3 Crack arrest hole in way of the block-to-block butt weld at the region where hatch side coaming weld meets the deck weld*, the corners of the crack arrest holes located where the hatch side coaming joints meet the deck weld are to be specially assessed for fatigue strength. The fatigue strength is also to be assessed at the location where the block-to-block butt weld intersects the crack arrest hole. Brittle crack arrest steel, as defined in *Pt 4, Ch 8, 2.3 Requirements for use of thick steel plates ~~2.3.12~~2.3.14,* is to be provided for the hatch side coaming plate.

(c) Where higher crack arrest steel insert plates such as SUF (Surface Layer with Ultra~~s~~-Fine grain) steel or equivalent, or weld metal inserts with high crack arrest toughness properties are provided in way of the block-to-block butt welds at the region where hatch side coaming weld meets the deck weld. Brittle crack arrest steel, as defined in *Pt 4, Ch 8, 2.3 Requirements for use of thick steel plates ~~2.3.12~~2.3.14*, is to be provided for the hatch side coaming plate.

(d) As an alternative to the mechanical measures (i.e. block offset, or crack arrest inserts, or crack arrest holes, or high arrest toughness welds), with the provision of crack arrest steel for the hatch coaming side plate stipulated in *Pt 4, Ch 8, 2.3 Requirements for use of thick steel plates ~~2.3.8.~~2.3.10.(a)*, *Pt 4, Ch 8, 2.3 Requirements for use of thick steel plates ~~2.3.8.~~ 2.3.10.(b)* and *Pt 4, Ch 8, 2.3 Requirements for use of thick steel plates ~~2.3.8.~~ 2.3.10.(c)*, enhanced non-destructive examination can be carried out in association with stricter acceptance criteria. The acceptance criteria are to be determined ~~through the means of an engineering critical assessment (ECA) to be carried out~~ in accordance with Chapter 2 of the *ShipRight Procedure for the Use of Enhanced NDE in Container Ships*, and the enhanced NDE is to be carried out in accordance with Chapter 3 of the *ShipRight Procedure for the Use of Enhanced NDE in Container Ships*. ~~Other mechanical means of crack arrest such as block shift, crack arrest insert plates and crack arrest holes are still to be fitted.~~ ~~This approach also requires a programme of non-destructive testing during the lifetime of the ship, see Pt 4, Ch 8, 2.3 Requirements for use of thick steel plates 2.3.10.~~ For areas of the weld which are inaccessible for enhanced NDE, alternative NDE procedures using the same acceptance criteria as the enhanced NDE are to be agreed with LR as described in the *ShipRight Procedure for the Use of Enhanced NDE in Container Ships*. The weld toughness of the block to block butt welds of the hatch coaming side plate, hatch coaming top plate and upper deck is to be as required by *Pt 4, Ch 8, 2.3 Requirements for use of thick steel plates ~~2.3.8~~2.3.13~~1~~* and EGW welding is not permitted.

~~2.3.9~~2.3.11 Where Measure ~~3~~4 is required in *Table 8.2.1 Preventative measures to be used in design and construction for thick steel plates* for the case~~s~~ given in *Pt 4, Ch 8, 2.3 Requirements for use of thick steel plates ~~2.3.4.~~2.3.5.(b)* ~~and *Pt 4, Ch 8, 2.3 Requirements for use of thick steel plates 2.3.4.2.3.5.(c)*~~, the use of brittle crack arrest steel, as defined in *Pt 4, Ch 8, 2.3 Requirements for use of thick steel plates ~~2.3.12.~~2.3.14*, for the upper deck along the cargo hold region is considered to be an acceptable means to arrest a brittle crack initiating from the coaming side and top plate and propagating into the structure below.

2.3.12 Where Measure 5 is required in *Table 8.2.1 Preventative measures to be used in design and construction for thick steel plates* for the case given in *Pt 4, Ch 8, 2.3 Requirements for use of thick steel plates 2.3.5(c)*, the use of brittle crack arrest steel, as defined in *Pt 4, Ch 8, 2.3 Requirements for use of thick steel plates 2.3.14*, for the upper deck along the cargo hold region is considered to be an acceptable means to arrest a brittle crack initiating from the coaming side and top plate and propagating into the structure below.

~~2.3.11~~ 2.3.13 Where enhanced NDE is used to achieve Measure ~~5~~ 3 ~~is required in *Table 8.2.1 Preventative measures to be used in design and construction for thick steel plates*~~ *see Pt 4, Ch 8, 2.3 Requirements for use of thick steel plates 2.3.10(d)*, the block to block butt welds of the hatch coaming side plate, hatch coaming top plate and upper deck are to have a minimum crack tip opening displacement (CTOD) value of 0,18 mm. The CTOD tests to confirm the CTOD value are to be carried out to the satisfaction of LR.

Table 8.2.1 Preventative measures to be used in design and construction for thick steel plates

Nominal yield strength (N/mm^2)	Thickness of hatch coaming plating *see* Note 3 & 4 (mm)	Measure, *see* Note 1				
		1	2	3+4	~~4~~5 ~~*see* Note 2~~	~~5~~ ~~see Note 4~~
355	50 < t ≤ 85	Not required	Not required	Not required	Not required	~~Not required~~
	85 < t ≤ 100	Required	Not required	Not required	Not required	~~Not required~~
390	50 < t ≤ 85	Required	Not required	Not required	Not required	~~Not required~~
	85 < t ≤ 100	Required	~~Required~~ *See* Note 2	Required	~~Not r~~Required	~~Not required~~ ~~*See* Note 4~~
460	50 < t ≤ ~~85~~100	Required	~~Required~~ *See* Note 2	Required	~~Not r~~Required	~~Not required~~ ~~*See* Note 4~~
	~~85 < t ≤ 100~~	~~Required~~	~~Required~~	~~Required~~	~~Not required~~	~~Not required~~

Key to measures:	
Measure 1:	NDE during construction on all upper flange longitudinal members, *see Pt 4, Ch 8, 2.3 Requirements for use of thick steel plates 2.3.~~7~~8*
Measure 2:	~~Block shift, crack arrest insert plates, crack arrest holes and enhanced NDE, *see Pt 4, Ch 8, 2.3 Requirements for use of thick steel plates 2.3.8*~~ Periodic in-service NDE, *see Pt 4, Ch 8, 2.3 Requirements for use of thick steel plates 2.3.9*
Measure 3:	~~Crack arrest steel for the upper deck, *see Pt 4, Ch 8, 2.3 Requirements for use of thick steel plates 2.3.9*~~ Either block shift, or crack arrest insert plates, or crack arrest holes or enhanced NDE, *see Pt 4, Ch 8, 2.3 Requirements for use of thick steel plates 2.3.10*
Measure 4:	~~Periodic in-service NDE, *see Pt 4, Ch 8, 2.3 Requirements for use of thick steel plates 2.3.10*~~ Crack arrest steel for the upper deck, *see Pt 4, Ch 8, 2.3 Requirements for use of thick steel plates 2.3.11*
Measure 5	Crack arrest steel for the upper deck, *see Pt 4, Ch 8, 2.3 Requirements for use of thick steel plates 2.3.12*
~~Measure 5:~~	~~Tough welds, *see Pt 4, Ch 8, 2.3 Requirements for use of thick steel plates 2.3.11 2.3.13*~~
Note 1. Measures are to be applied where 'Required' is shown. Note 2. Measure~~s 4~~2 ~~and 5 are only~~ may be required where enhanced NDE during construction has been applied as part of Measure ~~2~~4 Note 3. Hatch coaming plating includes side plating and top plating Note 4. Use of steels with thickness greater than 100mm will be specially considered	

~~2.3.12~~2.3.14 Brittle crack arrest steel is to be in accordance with *Table 8.2.2 Brittle crack arrest steel requirement in function of structural members and thickness* and as defined in the ~~Rules for Materials~~ *Rules and Regulations for the Classification of Materials, July 2020*, *Ch 3, 3 Higher strength steels for ship and other structural applications*.

2.3.15 The weld joints between the hatch coaming side and the upper deck are to be partial penetration welds approved by LR.

2.3.16 In the vicinity of ship block joints, alternative weld details may be used for the deck and hatch coaming side connection, provided additional means for preventing the crack propagation are implemented and agreed by LR in this connection area.

~~2.3.13~~2.3.17 Where higher crack arrest steel or weld inserts are proposed, as given in *Pt 4, Ch 8, 2.3 Requirements for use of thick steel plates ~~2.3.8.~~2.3.10.(c)*, the specific properties or grades of material are to be agreed with LR.

Table 8.2.2 Brittle crack arrest steel requirement in function of structural members and thickness

Structural Member Excluding Stiffeners	Thickness (mm)	Minimum specified yield stress (N/mm^2)	Brittle crack arrest steel type *See Rules for the Manufacture, Testing and Certification of Materials, July 2020*, Ch 3, 3 Higher strength steels for ship and other structural applications
Upper deck	$50 < t \leq 100$	355, 390	BCA1
Hatch coaming side	$50 < t \leq 80$	390, 460	BCA1
	$80 < t \leq 100$	390, 460	BCA2

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